CLAIMS

1. An optical transmission system having: a transmitter for converting a frequency division multiplexed signal to an optical signal and sending the optical signal onto an optical transmission path, the frequency division multiplexed signal being composed of first to n^{th} modulated signals (where n is an integer which is equal to or greater than two) having been subjected to a frequency division multiplex; a receiver for converting the optical signal having been transmitted over the optical transmission path back into the frequency division multiplexed signal, and separating the frequency division multiplexed signal into the first to n^{th} modulated signals; and first to n^{th} terminal devices which are connected to the receiver via the first to n^{th} connection lines, respectively, for receiving the separated modulated signals, the system comprising:

a peak detection section for detecting peak information concerning a peak of a signal level of the frequency division multiplexed signal;

a spurious calculation section for, based on the peak information detected by the peak detection section, calculating desired-to-undesired-signal information of the frequency division multiplexed signal, and determining signal level information concerning a signal level for the frequency division multiplexed signal which ensures that the

desired-to-undesired-signal information is equal to or greater than a predetermined level; and

a gain adjustment section provided in the transmitter for, based on the signal level information determined by the spurious calculation section, adjusting the signal level of the frequency division multiplexed signal when being converted to the optical signal.

2. The optical transmission system according to claim 1, wherein the transmitter includes:

first to n^{th} modulation sections for generating the first to n^{th} modulated signals based on first to n^{th} data signals to be transmitted to the first to n^{th} terminal devices;

a frequency division multiplex section for outputting the frequency division multiplexed signal by subjecting the first to n^{th} modulated signals which are output from the first to n^{th} modulation sections to a frequency division multiplex; and

an electrical-to-optical conversion section for converting into the optical signal the frequency division multiplexed signal which is output from the frequency division multiplex section, the signal level of the frequency division multiplexed signal having been adjusted by the gain adjustment section, and for sending the optical signal onto the optical transmission path, and

the receiver includes:

an optical-to-electrical conversion section for receiving the optical signal having been transmitted via the optical transmission path, and converting the optical signal back into the frequency division multiplexed signal; and

a frequency demultiplex section for extracting the first to n^{th} modulated signals from the frequency division multiplexed signal which is output from the optical-to-electrical conversion section, and sending the first to n^{th} modulated signals onto the first to n^{th} connection lines, respectively, and

the first to n^{th} terminal devices each include a demodulation section for demodulating the modulated signal which is transmitted over a corresponding one of the first to n^{th} connection lines.

3. The optical transmission system according to claim 2, wherein,

the desired-to-undesired-signal information is spurious information concerning a spurious component of the frequency division multiplexed signal occurring in the electrical-to-optical conversion section and the frequency division multiplexed signal itself, and

the spurious calculation section determines, as the signal level information, information concerning a signal level for the frequency division multiplexed signal which ensures that a level of the spurious component represented by the spurious information is equal to or less than a predetermined level.

4. The optical transmission system according to claim 3, wherein,

the peak information is expressed by a peak factor ξ, which represents a ratio of a peak power to an average power of the frequency division multiplexed signal,

the spurious information is expressed by an adjacent channel leakage power ratio, which is determined in terms of:

a spurious factor κ which is determined based on: a spurious amount, in accordance with the peak factor ξ, of a modulated signal corresponding to one channel; a level of second-order distortion which is in accordance with a given optical modulation index m in the electrical-to-optical conversion section; and a level of third-order distortion which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section;

a level of composite second-order distortion of the frequency division multiplexed signal which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section; and

a level of composite third-order distortion of the frequency division multiplexed signal which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section, and

the spurious calculation section determines, as the signal

level information, an optical modulation index m which ensures that the adjacent channel leakage power ratio is equal to or less than a predetermined level.

5. The optical transmission system according to claim 4, further comprising a ξ-m-κ table storage section for previously storing a ξ-m-κ table indicating correspondence between the peak factor ξ, the optical modulation index m in the electrical-to-optical conversion section, and the spurious factor κ,

wherein the spurious calculation section is operable to:

determine a spurious factor κ which corresponds to the peak factor ξ detected by the peak detection section, by referring to the ξ-m-κ table stored in the ξ-m-κ table storage section; and

search for an optical modulation index m which ensures that the adjacent channel leakage power ratio, which is expressed by the spurious factor κ, the level of composite second-order distortion, and the level of composite third-order distortion, is equal to or less than a predetermined level, and determines the optical modulation index m thus found as the signal level information.

6. The optical transmission system according to claim 2, wherein the desired-to-undesired-signal information is a

comprehensive signal quality ratio which is defined based on: spurious information concerning a spurious component of the frequency division multiplexed signal occurring in the electrical-to-optical conversion section; and carrier-to-noise information, and

the spurious calculation section determines, as the signal level information, information concerning a signal level for the frequency division multiplexed signal which ensures that the comprehensive signal quality ratio becomes maximum.

7. The optical transmission system according to claim 6, wherein,

the peak information is expressed by a peak factor ξ, which represents a ratio of a peak power to an average power of the frequency division multiplexed signal,

the spurious information is expressed by an adjacent channel leakage power ratio, which is determined in terms of:

a spurious factor κ which is determined based on: a spurious amount, in accordance with the peak factor ξ, of a modulated signal corresponding to one channel; a level of second-order distortion which is in accordance with a given optical modulation index m in the electrical-to-optical conversion section; and a level of third-order distortion which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section;

a level of composite second-order distortion of the frequency division multiplexed signal which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section; and

a level of composite third-order distortion of the frequency division multiplexed signal which is in accordance with the given optical modulation index m in the electrical-to-optical conversion section,

the carrier-to-noise information is expressed as a function of the optical modulation index m in the electrical-to-optical conversion section,

the optical transmission system further comprises:

a ξ-m-κ table storage section for previously storing a ξ-m-κ table indicating correspondence between the peak factor ξ, the optical modulation index m in the electrical-to-optical conversion section, and the spurious factor κ; and

a carrier-to-noise information storage section for previously storing correspondence between the optical modulation index m in the electrical-to-optical conversion section and the carrier-to-noise information,

the spurious calculation section is operable to:

determine a spurious factor κ which corresponds to the peak factor ξ detected by the peak detection section, by referring to the ξ-m-κ table stored in the ξ-m-κ table storage section;

determine the adjacent channel leakage power ratio which is expressed by the spurious factor κ, the level of composite second-order distortion, and the level of composite third-order distortion; and

determine, as the signal level information, an optical modulation index m in the electrical-to-optical conversion section which ensures that the comprehensive signal quality ratio, which is expressed by the adjacent channel leakage power ratio and the carrier-to-noise information, becomes maximum.

8. The optical transmission system according to claim 2, wherein the peak detection section detects the peak information by detecting the signal level of the frequency division multiplexed signal which is output from the frequency division multiplex section.

9. The optical transmission system according to claim 2, wherein the peak detection section detects the peak information based on information concerning peaks of the first to n^{th} modulated signals which are output from the first to n^{th} modulation sections.

10. The optical transmission system according to claim 2, wherein the peak detection section detects the peak information by detecting the signal level of the frequency division multiplexed signal which is output from the optical-to-electrical conversion

section.

11. The optical transmission system according to claim 2, wherein the peak detection section detects the peak information by detecting the signal levels of the first to n^{th} modulated signals which are output from the frequency demultiplex section.

12. The optical transmission system according to claim 2, wherein,

the frequency division multiplex section includes a frequency conversion section for converting the first to n^{th} modulated signals to signals having respectively different frequencies, and

the frequency demultiplex section includes an inverse frequency conversion section for converting the first to n^{th} modulated signals contained in the frequency division multiplexed signal to signals having their respective original frequencies.

13. The optical transmission system according to claim 2, wherein the spurious calculation section determines the desired-to-undesired-signal information in accordance with a number n of channels of modulated signals.

14. The optical transmission system according to claim 2, wherein the receiver further includes:

a distortion monitoring section for detecting a distortion level, at a predetermined frequency, of the frequency division multiplexed signal which is output from the electrical-to-optical conversion section; and

a distortion information transmission section for transmitting distortion level information to the transmitter, the distortion level information representing the distortion level which is detected by the distortion monitoring section, and

based on the distortion level information which is transmitted from the distortion information transmission section, the gain adjustment section adjusts the signal level of the frequency division multiplexed signal which is input to the electrical-to-optical conversion section so that the distortion level which is detected by the distortion monitoring section is equal to or less than a predetermined level.

15. The optical transmission system according to claim 2, wherein,

each terminal device further includes a quality detection section for detecting a signal quality of an output signal from the demodulated by the demodulation section, and transmitting the signal quality as signal quality information to the transmitter via the receiver, and

the gain adjustment section adjusts the signal level of the frequency division multiplexed signal which is input to the

electrical-to-optical conversion section so that the signal quality which is represented by the incoming signal quality information satisfies a predetermined quality level.

16. A transmitter for converting a frequency division multiplexed signal to an optical signal and sending the optical signal onto an optical transmission path, the frequency division multiplexed signal being composed of first to n^{th} modulated signals (where n is an integer which is equal to or greater than two) having been subjected to a frequency division multiplex, the transmitter comprising:

a peak detection section for detecting peak information concerning a peak of a signal level of the frequency division multiplexed signal;

a spurious calculation section for, based on the peak information detected by the peak detection section, calculating desired-to-undesired-signal information of the frequency division multiplexed signal, and determining signal level information concerning a signal level for the frequency division multiplexed signal which ensures that the desired-to-undesired-signal information is equal to or greater than a predetermined level; and

a gain adjustment section for, based on the signal level information determined by the spurious calculation section, adjusting the signal level of the frequency division multiplexed

signal when being converted to the optical signal.

17. A receiver for use in conjunction with a transmitter for converting a frequency division multiplexed signal to an optical signal and sending the optical signal onto an optical transmission path, the frequency division multiplexed signal being composed of first to n^{th} modulated signals (where n is an integer which is equal to or greater than two) having been subjected to a frequency division multiplex, the receiver converting the optical signal having been transmitted from the transmitter back into the frequency division multiplexed signal and separating the frequency division multiplexed signal into the first to n^{th} modulated signals, the receiver comprising:

a peak detection section for detecting peak information concerning a peak of a signal level of the frequency division multiplexed signal,

wherein,

the peak information detected by the peak detection section is used for calculating desired-to-undesired-signal information of the frequency division multiplexed signal, the desired-to-undesired-signal information being used for determining signal level information concerning a signal level for the frequency division multiplexed signal which ensures that the desired-to-undesired-signal information is equal to or greater than a predetermined level; and

the signal level information is used for adjusting the signal level of the frequency division multiplexed signal when being converted to the optical signal.

18. A signal level adjustment method for adjusting a signal level of a frequency division multiplexed signal for use in an optical transmission system having: a transmitter for converting a frequency division multiplexed signal to an optical signal and sending the optical signal onto an optical transmission path, the frequency division multiplexed signal being composed of first to n^{th} modulated signals (where n is an integer which is equal to or greater than two) having been subjected to a frequency division multiplex; a receiver for converting the optical signal having been transmitted over the optical transmission path back into the frequency division multiplexed signal, and separating the frequency division multiplexed signal into the first to n^{th} modulated signals; and first to n^{th} terminal devices which are connected to the receiver via the first to n^{th} connection lines, respectively, for receiving the separated modulated signals, the method comprising the steps of:

detecting peak information concerning a peak of a signal level of the frequency division multiplexed signal;

calculating desired-to-undesired-signal information of the frequency division multiplexed signal based on the detected peak information;

determining signal level information concerning a signal level for the frequency division multiplexed signal which ensures that the desired-to-undesired-signal information is equal to or greater than a predetermined level; and

based on the signal level information, adjusting the signal level of the frequency division multiplexed signal when being converted to the optical signal.